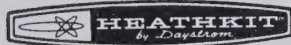
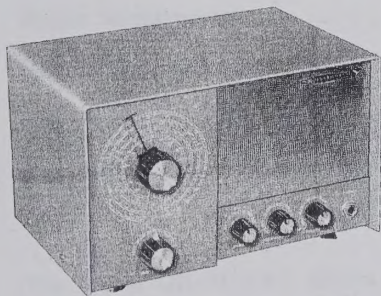


H7H SWC Radio GR-81

Assembly and Operation of the



SHORT WAVE LISTENERS RADIO MODEL GR-81



All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

HEATH COMPANY,
BENTON HARBOR,
MICHIGAN

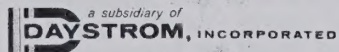


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SPECIFICATIONS

Frequency Coverage -	
Band A.	140 to 560 kilocycles.
Band B.	560 to 1730 kilocycles.
Band C.	1.73 to 5.5 megacycles.
Band D.	5.5 to 18 megacycles.
Audio Output.	1 watt to speaker (PHONES jack for headphones or external speaker).
Controls.	Main Tuning. FINE TUNING. BAND. REGENERATION. OFF/VOLUME.
Tube Complement.	12AT7 detector/audio amplifier. 50C5 audio output amplifier. 35W4 rectifier.
Antenna Inputs.	LONG and SHORT ANTENNA, GROUND.
Power Requirements.	117 V AC, 50/60 cps only, 30 watts.
Dimensions.	10" wide x 7" high x 7" deep.
Net Weight.	9-3/4 lbs.
Shipping Weight.	11-1/2 lbs.

INTRODUCTION

The Model GR-81 SWL (Short Wave Listener) Radio has been designed to provide a large scope of listening excitement from stations of many parts of the world. The four bands of frequencies that are covered will allow reception of the 160, 80, 40, and 20 meter amateur bands, marine signals, aircraft signals, distress frequencies, standard broadcasts, government stations, international broadcasts, etc. The Main

Tuning and FINE TUNING knobs make tuning simple. There are provisions for a short or a long antenna to cope with reception characteristics in various localities, depending on signal frequencies and strengths. The circuit of the Radio incorporates a filter choke in the power supply for a low hum level and a power isolation transformer to eliminate shock hazards normally common to series string, AC-DC circuits.

RADIO

Radio is a means of sending information through space from one point to another, without wires connecting the two points. The different forms of information transmitted are many and varied, but are frequently either sound waves produced by a voice or an orchestra, or a wave so interrupted that it is broken into a combination of long and short groups that correspond to the characters of the Morse code.

When an announcer speaks into a microphone in a radio broadcast station, the sound waves created by his voice are picked up by the microphone and changed into electrical impulses. The weak electrical impulses from the microphone are then fed into a transmitter. The transmitter amplifies or strengthens the weak signals from the microphone and transforms them into an electrical form that can be fed to an antenna and radiated

through space. Similarly, when the amateur radio operator talks into a microphone, the weak electrical impulses from the microphone are fed into a transmitter, antenna system, and radiated in much the same fashion as for standard broadcast stations.

When these electrical signals leave the transmitting antenna, they are called radio waves. They may spread out in all directions, or they may be beamed in one direction, depending on the type of transmitting antenna used.

A receiving antenna picks up a small part of these radio waves and feeds it into the receiver in the form of an electrical signal. For a receiver to be used effectively, it must separate the desired station from the many others. This is accomplished with one or more tuned circuits

which select one station and reject most others. The radio wave is then fed to a detector.

In the case of broadcast stations, the detector separates the audio frequency signal from the electrical signal that came from the transmitter; therefore the output of the detector is an audio signal. This is where the announcer's voice, or the orchestra, is restored to its original form.

This signal is often very weak, requiring that it be amplified to a point where it is strong enough to operate a headphone or loudspeaker.

The output of the detector is fed to an audio amplifier which increases the strength of the signal so it can operate headphones or a loudspeaker. These devices convert the electrical signal back into sound waves that can be heard.

CIRCUIT DESCRIPTION

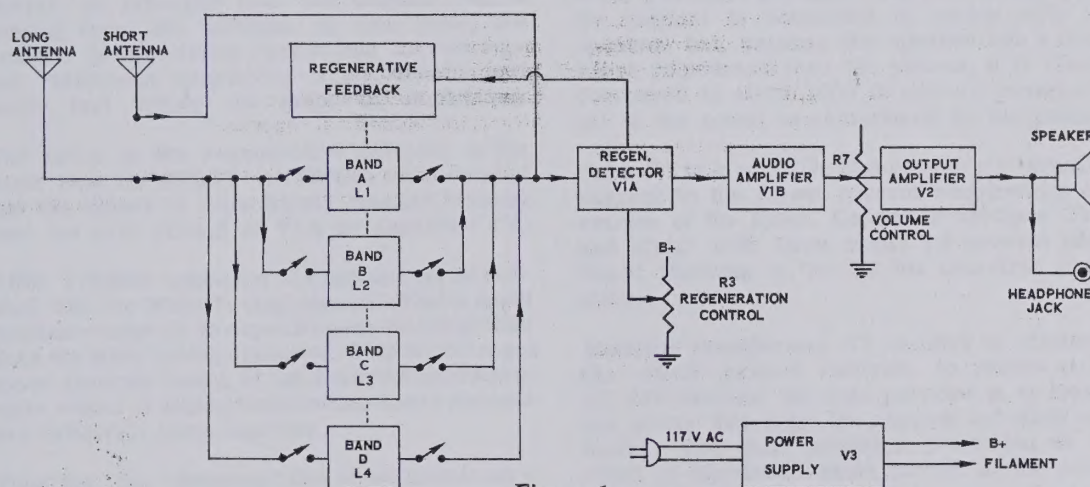


Figure 1

Refer to the Block Diagram of Figure 1 and to the Schematic Diagram on Page 9 for a better understanding of the following description.

With the antenna connected to the LONG ANTENNA input terminal (as would normally be the case with an adequate antenna), the signal received is applied to the primary winding of one of the coils; the coil is selected by the BAND switch. The secondary and tickler windings of this same coil are connected to the grid and plate circuits, respectively, of regenerative detector stage V1A. A different coil is used on

each band; that is, L1 for band A, L2 for band B, etc. The rear section of the Main Tuning capacitor is permanently connected across the Band A coil secondary, and is used in parallel with the front section of C3A to obtain enough capacity to tune the lower frequencies on Band A.

The signal received is coupled through the coil by transformer action to the secondary winding where it is tuned with Main Tuning capacitor C3B. This "selected" signal is fed to the grid circuit of V1A. Then it is amplified by tube action and appears in the plate circuit and tickler winding of

the same coil. The tickler winding is also transformer coupled to the secondary, such that a portion of the amplified signal appears back in the coil secondary to reinforce the original signal received by the antenna. This action is known as regeneration. The amount of regeneration (or re-amplification) is adjusted by controlling the gain of the tube. This is accomplished by adjusting the DC plate voltage on the tube by setting REGENERATION control R3.

When the REGENERATION control is set near its grounded end (counterclockwise), the voltage on the detector plate is very low. The result is that little regeneration takes place and the detector is quite insensitive. As this control is turned clockwise, the amount of regeneration and sensitivity increases until a point is reached where the detector goes into oscillation. This occurs when the signal fed back into the secondary winding by the action of the tube and tickler is stronger than the original signal coming from the antenna. At this point, the detector is effectively "producing its own signal." Maximum sensitivity of the detector will occur just before the point of oscillation.

The action of the regenerative detector is the same when the SHORT ANTENNA input is used and the signal is capacitively coupled directly into the grid circuit of V1A by capacitor C1.

FINE TUNING capacitor C4 (connected in parallel with the Main Tuning capacitor) has a much smaller variation in capacity over its range than does the Main Tuning capacitor. This allows much more accurate tuning of the desired signal and is quite useful at higher frequencies where stations are relatively close together.

Thus far, the "detector" has acted mainly as a very sensitive radio frequency amplifier. Actual

detection occurs because the currents in the detector plate circuit not only vary at the "carrier" radio frequency, but also vary with the intelligence placed upon the carrier at the transmitter. The much higher frequency carrier wave is removed by the filtering action of capacitor C6 and RF choke L5. For the most part, only the voice frequencies (in the case of a broadcast station) appear at the grid circuit of V1B.

V1B acts as a conventional audio amplifier that greatly increases the weak audio signal recovered by the detector. The output of V1B is capacitively coupled to VOLUME control R7. Depending on the setting of R7, all or a portion of the signal across it is fed to the grid of audio output tube V2. Tube V2 acts as a second stage of audio amplification, but is so designed to provide adequate power output to drive the output transformer and speaker.

When a headset is plugged into the PHONES jack, the headset is connected in series with the speaker, but, because the speaker has a much lower impedance than the phones, 8 Ω (ohms) compared to about 1000 Ω (ohms), practically all of the sound is reproduced by the phones.

Tube V3 is a rectifier that converts alternating current to the direct current required for operation of the tubes. Capacitor sections C11B and C11C with filter choke L6 provide additional filtering of the DC for hum-free operation.

Isolation transformer T2 is used to eliminate the shock hazard common to series-string AC-DC devices; its sole purpose is to isolate the power line from the chassis and other circuitry. The fuse provides protection in the event of accidental short circuit in the power supply circuit.

CONSTRUCTION NOTES

This manual is supplied to assist you in every way to complete your kit with the least possible chance for error. The arrangement shown is the result of extensive experimentation and trial. If followed carefully, the result will be a stable instrument, operating at a high degree of dependability. We suggest that you retain the manual in your files for future reference, both

in the use of the instrument and for its maintenance.

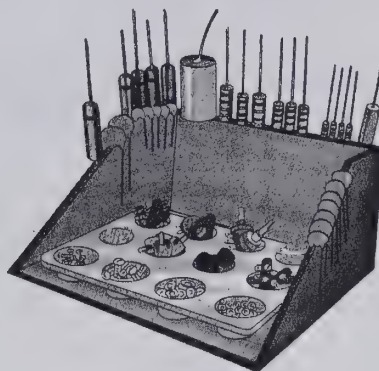
UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with the parts. Refer to the charts and other information on the inside covers of the manual to help you identify

the components. If some shortage or parts damage is found in checking the Parts List, please read the Replacement section and supply the information called for therein. Include all inspection slips in your letter to us.

Resistors generally have a tolerance rating of 10% unless otherwise stated in the Parts List. Tolerances on capacitors are generally even greater. Limits of +100% and -20% are common for electrolytic capacitors.

We suggest that you do the following before work is started:

1. Lay out all parts so that they are readily available.
2. Provide yourself with good quality tools. Basic tool requirements consist of a screwdriver with a 1/4" blade; a small screwdriver with a 1/8" blade; long-nose pliers; wire cutters, preferably separate diagonal cutters; a pen knife or a tool for stripping insulation from wires; a soldering iron (or gun) and rosin core solder. A set of nut drivers and a nut starter, while not necessary, will aid extensively in construction of the kit.



Most kit builders find it helpful to separate the various parts into convenient categories. Muffin tins or molded egg cartons make convenient trays for small parts. Resistors and capacitors may be placed with their lead ends inserted in the edge of a piece of corrugated cardboard until they are needed. Values can be written on the cardboard next to each component. The illustration shows one method that may be used.

PARTS LIST

The circled numbers in the Parts List are keyed to the circled numbers on the parts drawings to aid in parts identification.

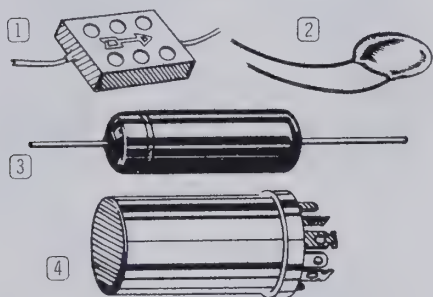
PART No.	PARTS Per Kit	DESCRIPTION	PART No.	PARTS Per Kit	DESCRIPTION
<u>Resistors</u>			1-34	1	680 K Ω 1/2 watt (blue-gray-yellow)
① 1-42	1	270 Ω 1/2 watt (red-violet-brown)	② 1A-19	1	220 Ω 1 watt (red-red-brown)
1-26	3	100 K Ω 1/2 watt (brown-black-yellow)	③ 1B-25	1	43 Ω 2 watt 5% (yellow-orange-black-gold)
1-33	1	470 K Ω 1/2 watt (yellow-violet-yellow)	④ 3E-16	1	175 Ω 5 watt wire-wound



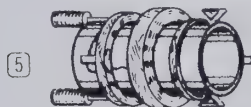
PART No.	PARTS Per Kit	DESCRIPTION
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Capacitors

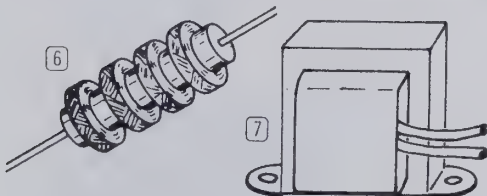
① 20-98	1	12 μmf mica 500 V
21-54	1	75 μmf disc ceramic 500 V
② 21-14	3	.001 μfd disc ceramic 500 V
21-26	1	.003 μfd disc ceramic 500 V
21-16	1	.01 μfd disc ceramic 500 V
③ 23-56	1	.5 μfd tubular 200 V
④ 25-65	1	50-50 μfd at 150 V, 20 μfd at 25 V electrolytic
26-85	1	4 μmf variable
26-81	1	323 μmf and 355 μmf 2-sec-tion variable

Coil Set (#141-27)Consisting of:

40-410	1	Coil (Band A)
⑤ 40-411	1	Coil (Band B)
40-412	1	Coil (Band C)
40-413	1	Coil (Band D)

Chokes-Transformers

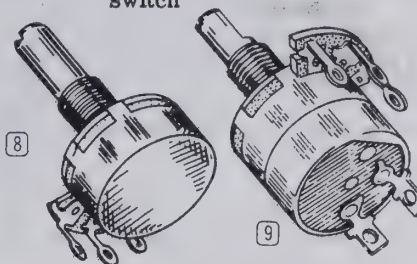
⑥ 45-4	1	1.1 mh RF choke
⑦ 46-3	1	Filter choke
51-83	1	Output transformer
54-121	1	Isolation transformer



PART No.	PARTS Per Kit	DESCRIPTION
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Controls-Switches

⑧ 10-12	1	100 K Ω control
⑨ 19-26	1	1 megohm control with switch
63-293	1	4-position, 3-wafer rotary switch

Grommets-Insulator-Wire

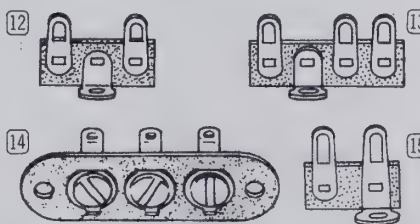
⑩ 73-1	4	Rubber grommet
⑪ 75-24	1	Line cord strain relief
89-1	1	Line cord
343-3	1	Length shielded cable
344-1	1	Length hookup wire
346-1	1	Length sleeving

Tubes-Lamp

411-24	1	12AT7 tube
411-55	1	35W4 tube
411-155	1	50C5 tube
412-13	1	Neon pilot lamp

Terminal Strips-Sockets-Knobs

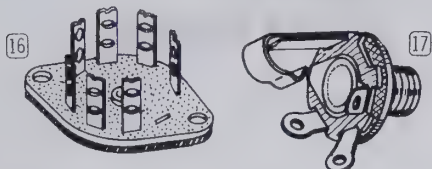
⑫ 431-2	2	2-lug terminal strip
⑬ 431-3	1	3-lug terminal strip
⑭ 431-8	1	3-screw terminal strip
⑮ 431-14	1	2-lug terminal strip (1 lug grounded)
⑯ 434-15	2	7-pin tube socket



PART No.	PARTS Per Kit	DESCRIPTION
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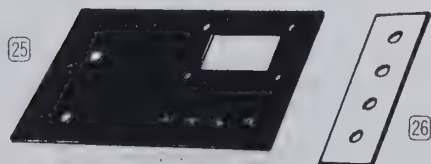
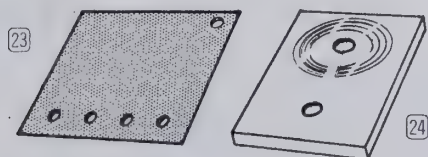
Terminal Strips-Sockets-Knobs (cont'd.)

434-16	1	9-pin tube socket
17 436-4	1	Phone jack
18 462-139	1	Medium knob
19 462-140	1	Large knob
20 462-159	3	Small knob
21 463-27	1	Snap-on knob pointer
22 463-28	1	2" knob pointer



Metal Parts

90-M206F	1	Cabinet
200-M335F665	1	Chassis
23 203-M288	1	Front decorative panel
24 203-M289F661	1	Front dial panel
25 203-M290F	1	Front subpanel
26 205-M342F662	1	Control plate
205-M343	1	Bottom chassis plate



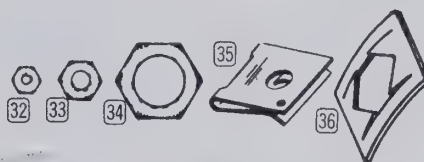
PART No.	PARTS Per Kit	DESCRIPTION
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Hardware

27 250-49	6	3-48 screw
28 250-56	12	6-32 x 1/4" screw
29 250-116	4	6-32 truss head screw (painted black)
30 250-170	6	#6 sheet metal screw
31 250-89	12	6-32 x 3/8" screw



32 252-1	6	3-48 nut
33 252-3	26	6-32 nut
34 252-7	10	Control nut
35 252-22	4	Speednut
36 252-32	1	Push-on speednut



37 253-10	4	Flat washer
38 254-7	7	#3 lockwasher
39 254-1	30	#6 lockwasher
40 254-4	1	Thick control lockwasher
41 254-5	2	Thin control lockwasher



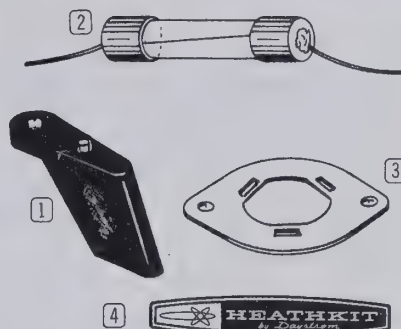
42 259-1	3	Large solder lug
43 259-6	1	Small solder lug
44 259-10	1	Control solder lug



45 255-2	3	Spacer
46 455-17	2	Brass bushing



PART No.	PARTS Per Kit	DESCRIPTION
Miscellaneous		
① 261-13	4	Plastic feet
② 421-17	1	3/4 ampere fuse (pigtail type)
401-40	1	Speaker
③ 481-2	1	Capacitor mounting wafer
331-6		Solder
595-510	1	Manual
④ 391-17	1	Nameplate



PROPER SOLDERING TECHNIQUES

Only a small percentage of HEATHKIT equipment purchasers find it necessary to return an instrument for factory service. Of these instruments, by far the largest portion of malfunctions are due to poor or improper soldering.

If terminals are bright and clean and free of wax, frayed insulation and other foreign substances, no difficulty will be experienced in soldering. Correctly soldered connections are essential if the performance engineered into a kit is to be fully realized. If you are a beginner with no experience in soldering, a half hour's practice with some odd lengths of wire may be a worthwhile investment.

For most wiring, a 25 to 100 watt iron or its equivalent in a soldering gun is very satisfactory. A lower wattage iron than this may not heat the connection enough to flow the solder smoothly over the joint. Keep the iron tip clean and bright by wiping it from time to time with a cloth.

CHASSIS WIRING AND SOLDERING

1. Unless otherwise indicated, all wire used is the type with colored insulation (hookup wire); In preparing a length of hookup wire, 1/4" of insulation should be removed from each end unless directed otherwise in the construction step.
2. To avoid breaking internal connections when stripping insulation from the leads of transformers or similar components, care should be taken not to pull directly on the lead. Instead, hold the lead with pliers while it is being stripped.
3. Leads on resistors, capacitors and similar components are generally much longer than they need to be to make the required connections. In these cases, the leads should be cut to proper length before the part is added to the chassis. In general, the leads should be just long enough to reach their terminating points.
4. Wherever there is a possibility of bare leads shorting to other parts or to the chassis, the leads should be covered with insulating sleeving. Where the use of sleeving is specifically intended, the phrase "use sleeving" is included in the associated construction step. In any case where there is the possibility of an unintentional short circuit, sleeving should be used. Extra sleeving is provided for this purpose.
5. Crimp or bend the wire around the terminal just enough to hold it in place until it is soldered. Do not knot or twist the wire around the lug. For the heavy bare wire, position the wire so that a good solder connection can be made.
6. Position the work, if possible, so that gravity will help to keep the solder where you want it.
7. Place a flat side of the soldering iron tip against the joint to be soldered until it is heated sufficiently to melt the solder.
8. Then place the solder against the heated terminal and it will immediately flow over

ANTENNA

ANTENNA AND GROUND CONNECTIONS

A suitable antenna and good ground system are a "must" for proper operation of this Radio. It is also strongly recommended that a lightning arrestor be used with the antenna for safety reasons. See Figure 2.

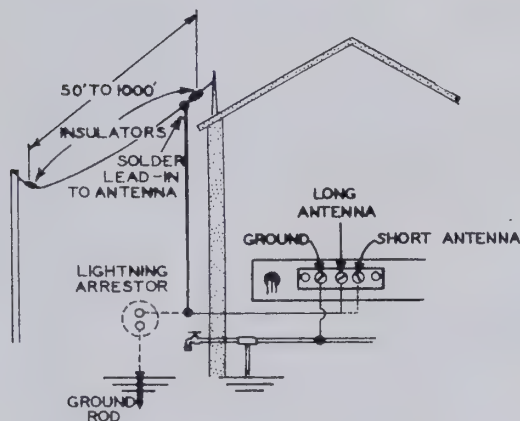


Figure 2

An adequate GROUND system consists of connecting a short length of wire from the ground terminal on the Radio to a nearby water pipe. A 6 to 8 foot ground rod driven into the earth will also work well when a good water pipe ground is not available or nearby.

Where all-wave coverage is desired, that is good reception for all frequencies, the best answer generally is, "the higher and longer the antenna, the better." Where particularly good reception is desired for a given frequency or band of frequencies, it is best to use an antenna designed for the frequencies in which you are interested. Several books on antennas are probably available from your local library. The ARRL (American Radio Relay League, West Hartford, Connecticut) Handbook contains information on antennas.

The wire used for the antenna may be either bare or insulated, but the lead-in wire from the antenna should be insulated where it touches other objects, such as poles, metal house siding, window stripping, etc. "Egg insulators," obtainable at your local hardware store, make excellent insulators where the antenna is tied to supporting structures. All wire splices or connections should be soldered to prevent noisy or erratic reception. Frequently a tree or pole may be used as one support and your house as the other. For a long antenna, it may be necessary to support the wire one or more times, near the middle. A copper coated steel wire (commercially known as "copperclad") makes excellent antenna wire and can be run for long spans without center supports.

ANTENNA TERMINALS

The type of antenna you use will have a great bearing on the overall performance of the Radio. It will also determine which antenna terminal will provide the most satisfactory results.

On Bands A and B, it is probable that the LONG ANTENNA input will provide better results, regardless of the length of antenna used. In areas where a strong broadcast signal is present, the use of the SHORT ANTENNA input may result in the strong station being heard in the background when tuning other stations. The use of the LONG ANTENNA input will result in much greater rejection of the unwanted signal, although some difficulty may still be experienced when tuning for weak signals close to an unwanted strong one.

On Bands C and D, using a relatively short antenna (say less than 50 feet), the SHORT ANTENNA input may provide better results. It should be pointed out that using the SHORT ANTENNA input will disturb the dial calibration and frequency range. It will be necessary to set the Main Tuning slightly higher than indicated on the dial to receive the same station. For proper dial calibration, the FINE TUNING pointer should be set straight up and the LONG ANTENNA terminal used.

OPERATION

CONTROLS

ON-OFF/VOLUME CONTROL - Turns the Radio on or off and varies the volume heard from the speaker or headphones.

REGENERATION CONTROL - Adjustment for the amount of regeneration in the detector circuit.

BAND SWITCH - Selects one of the four frequency ranges: A, B, C, or D.

MAIN TUNING - Tunes in the desired station. Note that the innermost dial (Band A) is calibrated in kilocycles (or thousandths of a megacycle), whereas the remaining bands are calibrated in megacycles; 1000 kc equals 1 mc.

FINE TUNING - Allows a finer adjustment or separation of the signals tuned with the Main Tuning control. In effect, this control tunes a very small portion of the frequency range where the Main Tuning control is set. For proper calibration of the main dial, the FINE TUNING control pointer should be set straight up. Then, with a signal tuned in on the main dial, the FINE TUNING will allow tuning signals slightly higher (turning clockwise from straight up) or lower (counterclockwise) than the setting on the main dial. This control is particularly useful on the higher frequencies (Bands C and D), although it is usable on all bands.

PHONES - Inserting a headset plug into this jack transfers the output of the Radio to the headset. A second speaker (4 or 8 Ω) can also be plugged in this jack, in which case both speakers will operate at slightly reduced maximum volume.

OPERATIONAL PROCEDURE

With antenna and ground leads attached and the BAND switch in the Band B position (broadcast coverage), turn both the VOLUME and REGENERATION controls fully clockwise and allow about one-half minute for warmup. In turning the Main Tuning dial, a series of beat notes or whistles will be heard which will decrease in pitch upon nearing a station, and increase as you are tuning away from the station. When listening to voice stations, the REGENERATION control should be set just below the point of oscillation; that is, just counterclockwise to

where the beat notes disappear. At this point, maximum sensitivity and selectivity will be achieved. It should be pointed out that this optimum setting of the REGENERATION control will change as the Main Tuning dial is rotated over any great distance and also will change from band to band. The tuning procedure on all bands is identical to this example.

For tuning CW (code stations), single-sideband (SSB), teletype, Consolan, or other stations requiring a beat note for reception, the REGENERATION control should be advanced into the oscillating condition. Maximum sensitivity here will occur when the detector is just barely oscillating. On strong signals it may be desirable to advance the control somewhat further to prevent "pulling" of the oscillating frequency by the incoming signal. This is particularly important when listening to a strong SSB station.

When tuning the upper extremes of Bands C and D, advancing the REGENERATION control may cause the detector to pass from the regenerative condition to the oscillating condition and, with further advancement, go on into "super-regeneration." This is a state where the detector actually goes in and out of oscillation at a very rapid rate (generally supersonic) and is a very sensitive condition of the detector which may be used for voice signals. For CW signals and others requiring a beat note, it will be necessary to "back down" the control into the oscillating condition, which may be a more critical adjustment than on the lower frequencies.

As mentioned previously, the FINE TUNING control may be used as a fine adjustment of the Main Tuning dial for more accurate tuning of an SSB or CW station, for instance. It should also be noted that not all tones or whistles received are the result of the detector being in oscillation. Some stations transmit a tone (aircraft beacons, etc.), while in other cases beat notes may be the result of two stations operating quite close to each other in frequency.

Band C may not show much activity during the daytime as signals in this frequency range generally do not travel great distances except at night (up to several hundred miles maximum during daytime).

RECEPTION GUIDE

THE FOLLOWING CHART IS PROVIDED AS A GUIDE FOR THE TYPES OF STATIONS AND SERVICES WHICH MAY BE RECEIVED ON THIS RADIO, ALONG WITH THEIR MOST LIKELY TIME OF RECEPTION.

FREQUENCY RANGE	TIME OF BEST RECEPTION	STATIONS OR SERVICES IN THIS RANGE
140-190 kc	Anytime - best during nighttime.	Government fixed and maritime coastal stations (CW and teletype) such as WCC (147 kc) and NSS (160 kc). European L.F. broadcast services (near 160 kc). Ship telegraph stations (maritime mobile).
190-200 kc	Anytime - best during nighttime.	Consolan stations (maritime radio navigation) such as Miami (MMF - 190 kc), San Francisco (SFI - 192 kc) and Nantucket (TUK - 194 kc).
200-415 kc	Anytime - best during nighttime.	Aeronautical mobile and radio navigation services. Maritime radio navigation. Airport "A-N" signals and weather reports. Coastal "homing" stations, etc.
415-490 kc	Anytime - best during nighttime.	Maritime mobile. Coast and ship stations (telegraphy).
490-510 kc	Anytime - best during nighttime.	International calling and distress band. Coastal and ship telegraphy.
510-535 kc	Anytime - best during nighttime.	Mobile (Region 2) and tone modulated telegraphy.
535-1,605 mc	Anytime - best during nighttime.	Commercial broadcast band.
1,605-2,000 mc	Generally nighttime only.	Frequency range includes 160 meter amateur band (1.8 to 2.0 mc), Loran (Long-Range-Navigation) at 1.85 and 1.95 mc, maritime mobile, aeronautical fixed and radio navigation.
2,00-2,85 mc	Generally nighttime only - except for local stations.	Coastal and maritime mobile stations, both voice and telegraphy. International calling and distress frequency 2,182 mc. Ship-to-ship frequency 2,638 mc. WWV frequency and time standard, 2,500 mc.
2,850-3,500 mc	Generally nighttime only	Aeronautical fixed and mobile coastal and ship stations. International broadcast service and industrial use.
3,5-4,0 mc	Generally late afternoon to early morning except "local"	80 meter amateur band; telegraphy throughout, although largely 3.5 to 3.8 mc, voice 3.8 to 4.0 mc.
4,00-4,75 mc	Anytime - best during nighttime	Aircraft, aeronautical fixed, maritime mobile (ship telegraphy and voice), some teletype and industrial, military affiliated radio service, etc.

4.75-7.0 mc	Anytime - best during night-time	Includes international broadcasting 4.75 to 5.06 mc and 5.95 to 6.2 mc (49 meter band) aeronautical fixed and mobile, coastal and ship telegraph stations, WWV frequency and time standard at 5.000 mc.
7.000-7.300 mc	Anytime - most reliable during evening or early morning	40 meter amateur band; telegraph 7.00-7.20 mc, voice 7.20-7.30 mc.
7.3-8.195 mc	Anytime	Aeronautical and international public land stations.
8.195-8.815 mc	Anytime	Maritime ship and coastal stations (both voice and telegraphy).
8.815-9.5 mc	Anytime	Aeronautical mobile and fixed stations.
9.5-9.775 mc	Anytime - best during evening or early morning.	31 meter international broadcast band.
9.775-11.70 mc	Anytime	Aeronautical fixed and mobile. WWV frequency and time standard at 10.000 mc.
11.70-11.975 mc	Anytime	25 meter international broadcast band.
11.975-14.00 mc	Anytime	Aeronautical fixed and mobile, maritime coastal and ship stations (both voice and telegraphy) between 12.33 and 13.2 mc.
14.000-14.350 mc	Anytime - frequently unreliable during nighttime	20 meter amateur band; telegraphy 14.00-14.200, voice 14.200-14.350.
14.350-15.10 mc	Anytime - frequently unreliable during nighttime	Aeronautical fixed and mobile. WWV frequency and time standard at 15.000 mc.
15.100-15.450 mc	Anytime - frequently unreliable during nighttime	19 meter international broadcast band.
15.450-17.70 mc	Most reliable during daytime	Aeronautical fixed, maritime coastal and ship stations (voice and telegraphy).
17.70-17.90 mc	Most reliable during daytime	16 meter international broadcast band.

** These reception conditions are subject to varying atmospheric conditions, sun spot activities, and to some extent weather conditions. In the winter, reception generally will be best on the lower frequency bands. In summer, reception will be better on higher frequency bands.

BIBLIOGRAPHY

There are numerous books available that list station call letters, locations, frequencies, schedules, and other useful information.

The "World Radio Handbook" lists all of the world's shortwave broadcast stations as well as many standard broadcast stations...Gilfer Associates, PO Box 239, Grand Central Station, New York, New York.

"Broadcasting Stations of the World," published every two years by the United Nations Information Agency, lists stations alphabetically by slogan and call letters....Superintendent of Documents, Washington 25, D.C. (Ask for Part III.) "White's Radio Log," an old and famous listing of U.S. and Canadian broadcast stations, is now contained in "Radio-TV Experimenter," found on the newstands every March and September.

The Communication Engineering Book Company, Monterey, Massachusetts, publishes "call books" of police, power company, forest patrol, aviation, etc., communications systems.

"Radio Amateur Call Book Magazine," known universally as "Callbook," published quarterly, lists every radio amateur alphabetically by call, giving name and address, U.S. and Foreign stations are in separate volumes....Radio Call Book, Inc., Chicago 29, Illinois.

The American Radio Relay League, West Hartford, Connecticut, publishes the famous "Radio Amateur's Handbook" and the "ARRL Antenna Book." Both books carry valuable technical information. (NOTE: "Callbook" and ARRL publications are available at most parts distributors.)

IN CASE OF DIFFICULTY

GENERAL CHECKS

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.
2. It is interesting to note that about 90% of the kits that are returned for repair, do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the Proper Soldering Techniques section of this manual.
3. Check to be sure that all tubes are in their proper locations. Make sure that all tubes light up properly.
4. Check the tubes with a tube tester or by substitution of tubes of the same types and known to be good.
5. Check the values of the component parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.
6. Check for accidental short circuits and bits of solder, wire ends, or other foreign matter which may be lodged in the wiring. In particular on shielded wire, make certain the shield braid does not accidentally short to the inner conductor.
7. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those found on the Schematic Diagram. NOTE: All voltage readings were taken with an 11 megohm input vacuum tube voltmeter. Voltages may vary as much as 10% due to line voltage variations.
8. A review of the Circuit Description will prove helpful in indicating where to look for trouble.

SPECIFIC CHECKS

1. TUBES-PILOT LAMP - If the pilot lamp and tubes do not light properly, this would indicate that the trouble is in the power supply section, associated with the 35W4 tube (V3). Possible causes could be:

Open fuse.
On-off switch open or wired improperly.
Defective tube (any of the three as the heaters are wired in series).
An error in the tube heater wiring.
Open resistor R10 or R11.
Open isolation transformer winding or open filter choke.
Filter capacitor wired improperly or shorted (note that only two of the three sections of C11 are similar, the third is electrically different).
A short circuit in any chassis wiring or component electrically common to pin 6 of the 50C5 tube (V2).
Leads of pilot lamp shorted together.

2. AUDIO OUTPUT STAGE - If all tubes and the pilot lamp light properly, there should be a faint hum heard in the speaker (headphone plug removed). If this is not the case, this would tend to indicate trouble in the 50C5 tube (V2) section, such as:

Defective 50C5.
Wiring error in the output transformer (T2), speaker, or PHONES jack circuitry.
Open output transformer, shorted capacitor C10 or open resistor R7 or R8.

3. AUDIO TEST - Turn the VOLUME control completely clockwise and the REGENERATION control fully counterclockwise. Now, very carefully touch lug 7 of the 12AT7 tube socket (V1) with the tip of a metal screwdriver while making contact with the screwdriver blade with your finger. A loud buzz

or hum should be heard in the speaker. Be very cautious not to touch anything else. Failure to obtain proper results here might be caused by:

Defective 12AT7 tube (V1).
Center conductor of the shielded wiring shorted to chassis or shield braid.
Defective resistor R4, R6, R7 or capacitor C9.

4. DETECTOR - Advance the REGENERATION control approximately one-quarter turn with the VOLUME control on full; as described earlier, and again using caution, touch lug 2 of the 12AT7 socket (V1) with the screwdriver. A loud hum should be heard, although it should sound somewhat different and louder than at lug 7 in the previous step. Failure to obtain proper results here could be caused by:

Defective 12AT7 tube.
Short circuit in the tickler section of the BAND switch wiring.
Shorted capacitor C6, or shorted or open capacitor C7.
Open RFC (L5).
Open resistor R2 or R3.

5. COIL AND BAND SWITCH SECTION - If all tests so far check out, a careful inspection of the coil and BAND switch wiring is in order. It would be desirable to check the voltages present on tube socket V1 with a vacuum tube voltmeter. Note that the voltage on the plate of the detector (pin 1 of the 12AT7) will vary as the REGENERATION control setting changes, increasing with clockwise rotation. The voltage at the grid (pin 2) should also vary negatively in the same manner, but should remain constant over a portion of the counterclockwise range of the REGENERATION control.

SERVICE INFORMATION

SERVICE

If, after applying the information contained in this manual and your best efforts, you are still unable to obtain proper performance, it is suggested that you take advantage of the technical facilities which the Heath Company makes available to its customers.

The Technical Consultation Department is maintained for your benefit. This service is available to you at no charge. Its primary purpose is to provide assistance for those who encounter difficulty in the construction, operation or maintenance of HEATHKIT equipment. It is not intended, and is not equipped to function as a general source of technical information involving kit modifications nor anything other than the normal and specified performance of HEATHKIT equipment.

Although the Technical Consultants are familiar with all details of this kit, the effectiveness of their advice will depend entirely upon the amount and the accuracy of the information furnished by you. In a sense, **YOU MUST QUALIFY** for GOOD technical advice by helping the consultants to help you. Please use this outline:

1. Before writing, fully investigate each of the hints and suggestions listed in this manual under In Case Of Difficulty. Possibly it will not be necessary to write.
2. When writing, clearly describe the nature of the trouble and mention all associated equipment. Specifically report operating procedures, switch positions, connections to other units and anything else that might help to isolate the cause of trouble.
3. Report fully on the results obtained when testing the unit initially and when following the suggestions under In Case Of Difficulty. Be as specific as possible and include voltage readings if test equipment is available.
4. Identify the kit model number and date of purchase, if available. Also mention the date of the kit assembly manual. (Date at bottom of Page 1.)
5. Print or type your name and address, preferably in two places on the letter.

With the preceding information, the consultant will know exactly what kit you have, what you would like it to do for you and the difficulty you wish to correct. The date of purchase tells him whether or not engineering changes have been made since it was shipped to you. He will know what you have done in an effort to locate the cause of trouble and, thereby, avoid repetitious suggestions. In short, he will devote full time to the problem at hand, and through his familiarity with the kit, plus your accurate report, he will be able to give you a complete and helpful answer. If replacement parts are required, they will be shipped to you, subject to the terms of the Warranty.

The Factory Service facilities are also available to you, in case you are not familiar enough with electronics to provide our consultants with sufficient information on which to base a diagnosis of your difficulty, or in the event that you prefer to have the difficulty corrected in this manner. You may return the completed instrument to the Heath Company for inspection and necessary repairs and adjustments. You will be charged a minimal service fee, plus the price of any additional parts or material required. However, if the completed kit is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase, if possible.

Local Service by Authorized HEATHKIT Service Centers is also available in some areas and often will be your fastest, most efficient method of obtaining service for your HEATHKIT equipment. Although you may find charges for local service somewhat higher than for factory service, the amount of increase is usually offset by the transportation charge you would pay if you elected to return your kit to the Heath Company.

HEATHKIT Service Centers will honor the regular 90 day HEATHKIT Parts Warranty on all kits, whether purchased through a dealer or directly from Heath Company; however, it will be necessary that you verify the purchase date of your kit.

Under the conditions specified in the Warranty, replacement parts are supplied without charge; however, if the Service Center assists you in

locating a defective part (or parts) in your kit, or installs a replacement part for you, you may be charged for this service.

HEATHKIT equipment purchased locally and returned to Heath Company for service must be accompanied by your copy of the dated sales receipt from your authorized HEATHKIT dealer in order to be eligible for parts replacement under the terms of the Warranty.

THIS SERVICE POLICY APPLIES ONLY TO COMPLETED EQUIPMENT CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Equipment that has been modified in design will not be accepted for repair. If there is evidence of acid core solder or paste fluxes, the equipment will be returned NOT repaired.

For information regarding modification of HEATHKIT equipment for special applications, it is suggested that you refer to any one or more of the many publications that are available on all phases of electronics. They can be obtained at or through your local library, as well as at most electronic equipment stores. Although the Heath Company sincerely welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for special purposes. Therefore, such modifications must be made at the discretion of the kit builder, using information available from sources other than the Heath Company.

REPLACEMENTS

Material supplied with HEATHKIT products has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally, improper operation can be traced to a faulty component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information.

- A. Thoroughly identify the part in question by using the part number and description found in the manual Parts List.
- B. Identify the type and model number of kit in which it is used.

C. Mention date of purchase.

D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. PLEASE DO NOT RETURN THE ORIGINAL COMPONENT UNTIL SPECIFICALLY REQUESTED TO DO SO. Do not dismantle the component in question as this will void the guarantee. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

SHIPPING INSTRUCTIONS

In the event that your instrument must be returned for service, these instructions should be carefully followed.

Be sure to return the tubes and secure the cabinet in place.

Wrap the equipment in heavy paper, exercising care to prevent damage. Place the wrapped equipment in a stout carton of such size that at least three inches of shredded paper, excelsior, or other resilient packing material can be placed between all sides of the wrapped equipment and the carton. Close and seal the carton with gummed paper tape, or alternately, tie securely with stout cord. Clearly print the address on the carton as follows:



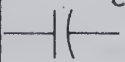
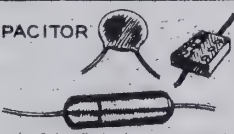
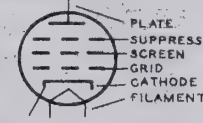

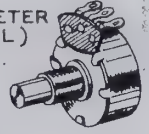
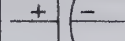
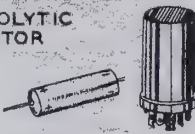



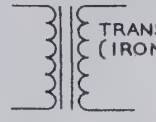
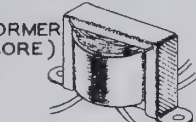

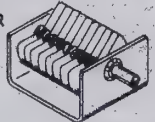

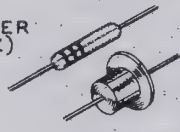
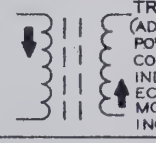
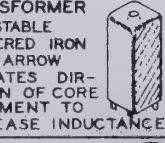
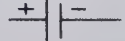


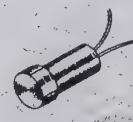

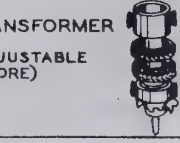
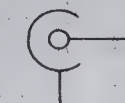
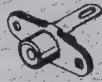


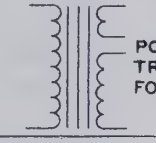
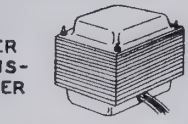





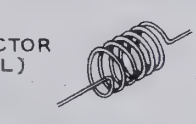


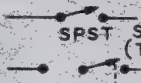
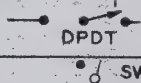
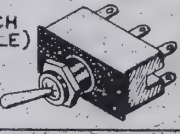

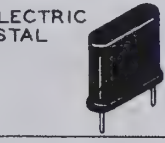
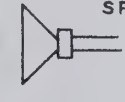

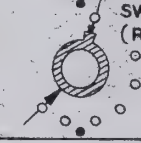


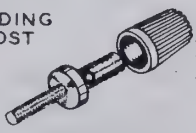
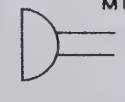
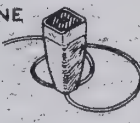

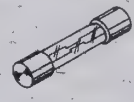


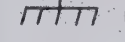



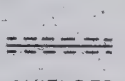
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Benton Harbor, Michigan

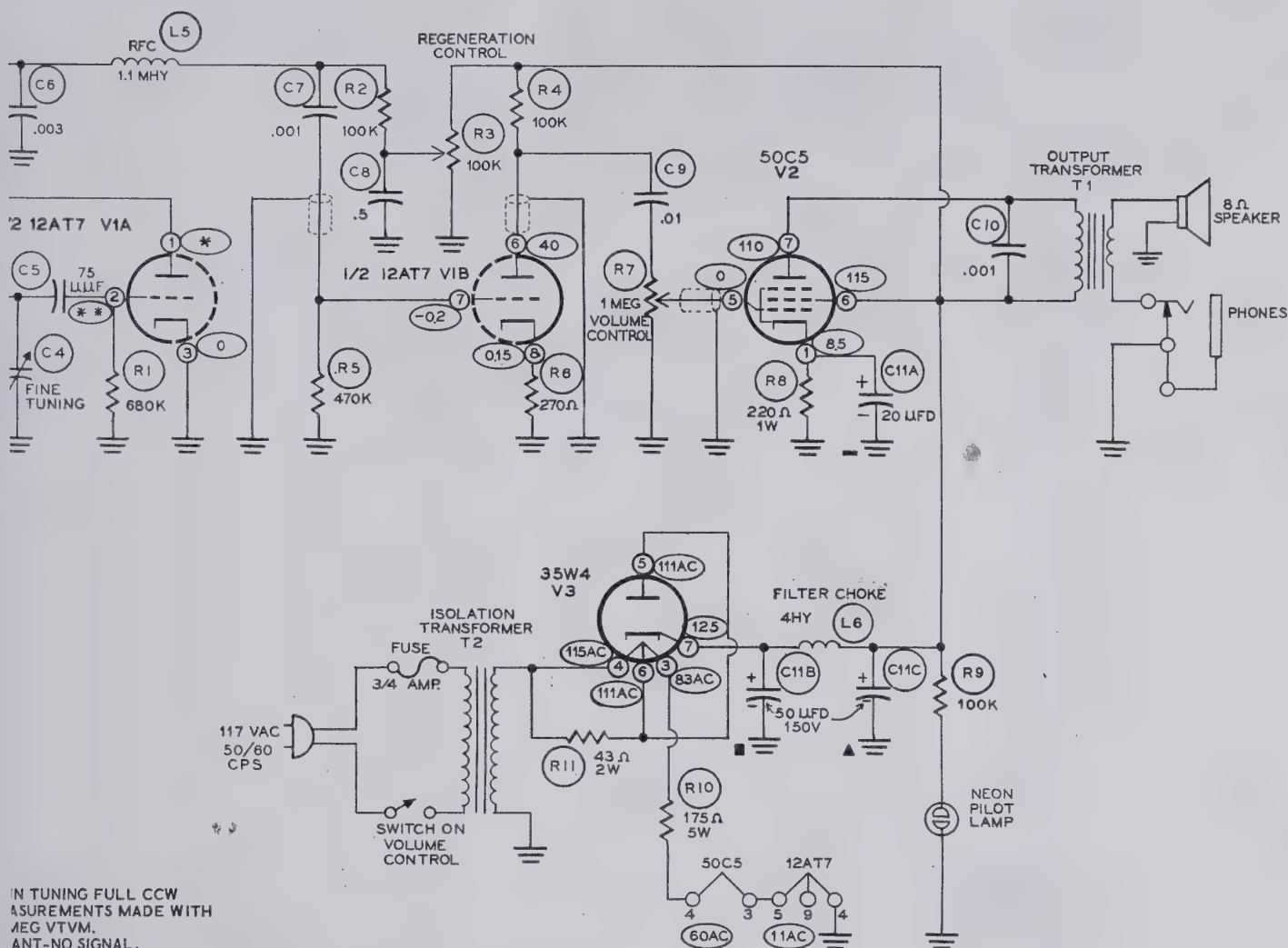
ATTACH A LETTER TO THE OUTSIDE OF THE CARTON BEARING YOUR NAME, COMPLETE ADDRESS, DATE OF PURCHASE, AND A BRIEF DESCRIPTION OF THE DIFFICULTY ENCOUNTERED. Also, include your name and return address on the outside of the carton. Preferably affix one or more "Fragile" or "Handle With Care" labels to the carton, or otherwise so mark with a crayon of bright color. Ship by insured parcel post or prepaid express; note that a carrier cannot be held responsible for damage in transit if, in HIS OPINION, the article is inadequately packed for shipment.

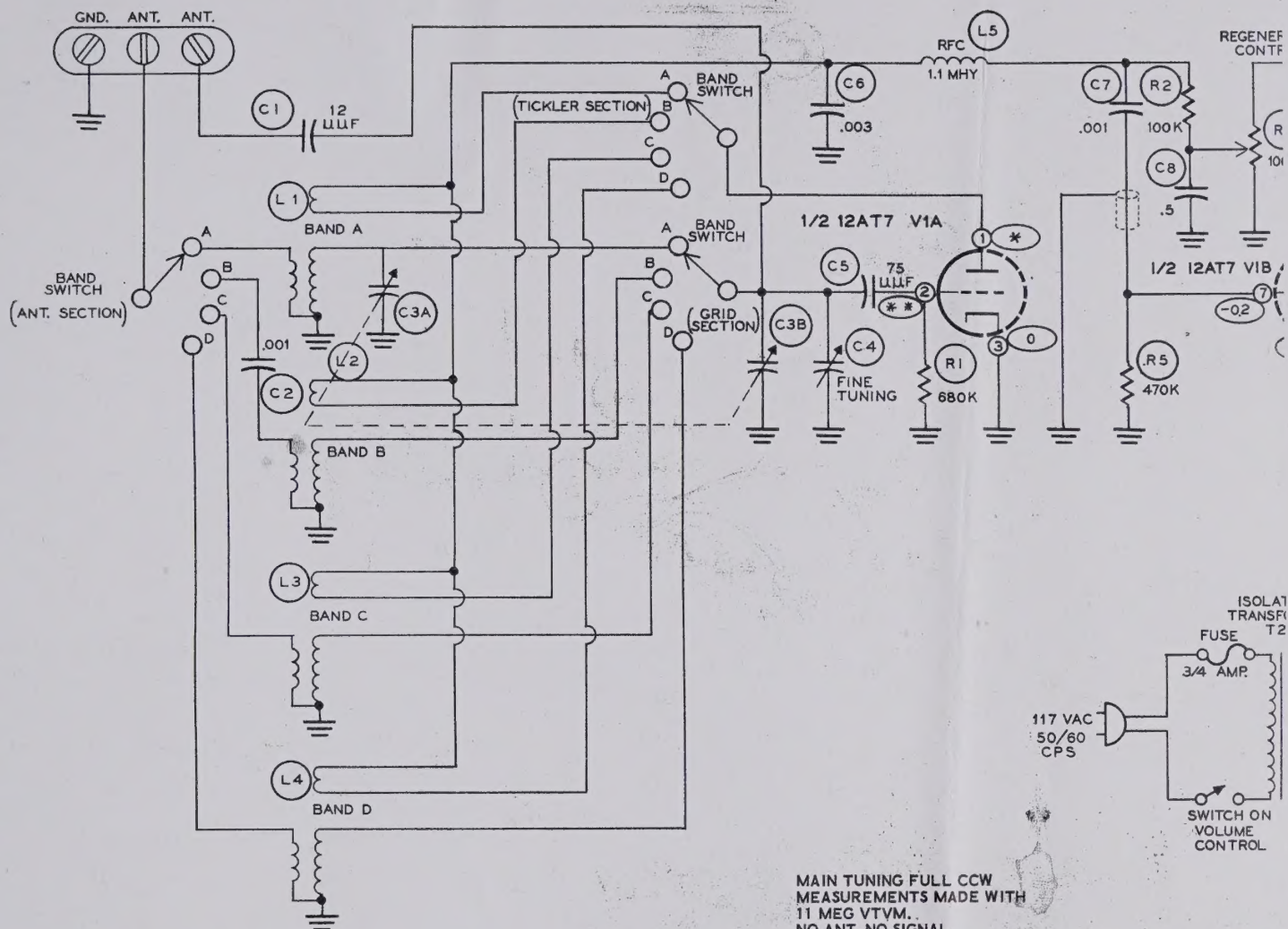
TYPICAL COMPONENT TYPES

This chart is a guide to commonly used types of electronic components. The symbols and related illustrations

should prove helpful in identifying most parts and reading the schematic diagrams.

RESISTOR  	CAPACITOR  	 TUBE PLATE SUPPRESSOR SCREEN GRID CATHODE FILAMENT
POTENTIOMETER (CONTROL)  	ELECTROLYTIC CAPACITOR  	TRANSISTOR PNP BASE COLLECTOR EMITTER NPN BASE COLLECTOR EMITTER   
TRANSFORMER (IRON CORE)  	VARIABLE CAPACITOR  	RECTIFIER (DIODE)  
TRANSFORMER (ADJUSTABLE POWDERED IRON CORE) ARROW INDICATES DIRECTION OF CORE MOVEMENT TO INCREASE INDUCTANCE  	BATTERY  	 NEON BULB 
TRANSFORMER (ADJUSTABLE CORE)  	PHONO JACK  	 ILLUMINATING BULB 
POWER TRANSFORMER  	PHONE JACK  	METER  
INDUCTOR (COIL)  	RECEPTACLE  	SWITCH (TOGGLE) SPST DPDT   
PIEZOELECTRIC CRYSTAL  	SPEAKER  	SWITCH (ROTARY)  
BINDING POST  	MICROPHONE  	FUSE  
ANTENNA GENERAL  LOOP 	EARTH GROUND  CHASSIS GROUND 	CONDUCTORS NOT CONNECTED  CONNECTED  SHIELDED 





**SCHEMATIC OF THE
HEATHKIT®
SHORT WAVE LISTENERS RADIO
MODEL GR-81**

MAIN TUNING FULL CCW
MEASUREMENTS MADE WITH
11 MEG VTVM.
NO ANT-NO SIGNAL.
ALL VOLTAGES DC UNLESS OTHERWISE
INDICATED AND POSITIVE WITH RESPECT
TO CHASSIS.
*0-40 VOLTS DEPENDING UPON SETTING
OF "REGENERATION" CONTROL.
** -0.5 VOLTS WITH REGENERATION CONTROL
FULL CCW TO SEVERAL VOLTS NEGATIVE
WITH CONTROL FULLY CW.
ALL CAPACITOR VALUES ARE IN μ F UNLESS
OTHERWISE MARKED.

○ INDICATES PART NUMBER DESIGNATION.
○ INDICATES VOLTAGE.

